

LONDON- WEST MIDLANDS ENVIRONMENTAL STATEMENT

Volume 5 | Technical Appendices

CFA23 | Balsall Common and Hampton-in-Arden

Water resources assessment (WR-002-023)

Water resources

November 2013

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Department
for Transport

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Appendix WR-002-023

Environmental topic:	Water resources and flood risk assessment	WR
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1 Introduction

1.1 Structure of the water resources and flood risk assessment appendices

- 1.1.1 The water resources and flood risk assessment appendices comprise three parts. The first of these is a route-wide appendix (Volume 5: Appendix WR-001-000).
- 1.1.2 Several specific appendices for this community forum area (CFA) are also provided. For the Balsall Common and Hampton-in-Arden area (CFA23) these are:
- a water resources assessment (i.e. this appendix);
 - a flood risk assessment (Volume 5: Appendix WR-003-023);
 - River Blythe catchment preliminary flow calculations technical report (Volume 5: Appendix WR-004-016); and
 - River modelling of Bayleys Brook (at Marsh Farm and Lavender Hall Lane), the River Blythe Bypass, Shadow Brook and Hollywell Brook technical report (Volume 5: Appendix WR-004-018).
- 1.1.3 Maps referred to throughout the water resources and flood risk assessment appendices are contained in the Volume 5 Map Book Water resources.

1.2 Study area

- 1.2.1 The spatial scope of the assessment was based upon the identification of surface water and groundwater features within 1km of the centre line of the route, except where there is clearly no hydraulic connectivity. For surface water features in urban areas, the extent was reduced to 500m. Outside of these distances it is unlikely that direct impacts upon the water environment will be attributable to the Proposed Scheme. Where works extend more than 200m from the centre line, for example at stations and depots, professional judgement has been used in selecting the appropriate limit to the extension in spatial scope required. For the purposes of this assessment this spatial scope is defined as the study area.
- 1.2.2 The study area for CFA23 extends from Berkswell at its southern boundary to Hampton-in-Arden (south-east of the A45 Coventry Road) at its northern boundary in the borough of Solihull. The area is predominantly rural in character, with agriculture being the main land use interspersed with small villages and a scattering of isolated dwellings and farmsteads. The area is contained within the catchment of the River Blythe, with the tributaries of Bayleys Brook and Shadow Brook. The River Blythe has an associated floodplain and the channel is designated as a site of special scientific interest (SSSI). Underlying the area are two Secondary A aquifers and one Secondary B aquifer. The Proposed Scheme will skirt an area of outcropping Bromsgrove Sandstone Formation, which is also a Principal aquifer.
- 1.2.3 The main environmental features of relevance to water resources and flood risk include:

- the River Blythe channel is designated as a SSSI, extending northwards west of Balsall Common, and east of Hampton-in-Arden, and Berkswell Marsh SSSI;
- The floodplain of the River Blythe and its tributaries, the Bayleys Brook and Shadow Brook. The River Blythe and Shadow Brook are Main Rivers, with the Bayleys Brook being an ordinary watercourse;
- Marsh Lane Nature Reserve, and two water dependent Local Wildlife Sites (LWS) - Patrick Farm Meadow and Mouldings Green Farm Meadow;
- two Secondary A aquifers (the permeable superficial deposits and the Arden Sandstone Formation); one Secondary B aquifer (the Mercia Mudstone Formation); and one Principal aquifer (the Tile Hill Mudstone Formation). The Proposed Scheme will skirt an area of outcropping Bromsgrove Sandstone Formation, which is also a Principal aquifer; and
- one licensed groundwater abstraction and three private groundwater users, which abstract from the Mercia Mudstones.

1.2.4 Key environmental aspects relating to water resources and flood risk include:

- the potential lowering of groundwater levels and disturbance of any existing poor quality ground or groundwater by temporary dewatering during construction and by permanent groundwater control during operation;
- potential obstruction of groundwater flow by below ground construction and permanent structures following construction and operation;
- potential creation or alteration of contaminant pathways during construction and operation on groundwater quality;
- realignments of Bayleys Brook, under Balsall Common viaduct, a tributary of Bayleys Brook at Lavender Hall Lane, an unnamed tributary of Bayleys Brook re-entering the Brook near Marsh Farm viaduct and the Horn Brook; and
- construction activities taking place within floodplains including River Blythe, Bayleys Brook and Shadow Brook.

2 Stakeholder engagement

2.1.1 Consultation with the following stakeholders has been undertaken to inform the water resources assessment:

- Environment Agency with regard to the proposed realignments of the Bayleys Brook within the River Blythe catchment, discussions regarding the modelling of river flooding and flood risk aspects;
- Canal & River Trust;
- Natural England in connection with the River Blythe SSSI and the Berkswell Marsh SSSI; and
- Solihull Metropolitan Borough Council (SMBC), Warwickshire County Council (WCC) and North Warwickshire District Council (NWDC) as Lead Local Flood Authorities with regard to surface water, flood risk and drainage in the study area and to identify any private groundwater abstractions and Severn Trent Water Ltd with regard to drainage.

3 Baseline data

3.1 General

3.1.1 The following section provides a current description of water resources including surface water and groundwater.

3.2 Surface water features

3.2.1 All surface water features within 1km of the route are presented in Table 1.

3.2.2 The current surface water baseline is shown on Volume 5: Map WR-03-039 and Map WR-03-040. All surface water features are based on the Environment Agency's Digital River network.

3.2.3 All water bodies in this area fall within the Tame, Anker and Mease sub-catchment of the Humber River Basin District (RBD) and associated river basin management plan (RBMP).

3.2.4 The River Blythe is a major tributary of the River Tame and drains parts of North Warwickshire, Solihull and the surrounding rural areas. It has a total catchment of 131km² upstream of a point on the river 400m north of Patrick Bridge. It is a main river and the channel is designated as a SSSI. Its tributary, Shadow Brook is also classified as a Main River. Bayleys Brook is classified as an ordinary watercourse.

3.2.5 The descriptive values ascribed to surface water receptors in Table 1 below have been derived in accordance with the Scope and Methodology Report (SMR) (see Volume 5: CT-001-000/1) and the SMR Addendum (see Volume 5: Appendix CT-001-000/2).

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Table 1: Surface water features within 1km of the route in CFA23

Water feature	Location description	Watercourse classification ¹	Water Framework Directive ² (WFD) water body and overall status	WFD status objective (by 2027 ³) as per river basin management plan (RBMP)	Receptor value ⁴	Q95 (m ³ /s)	Catchment/s	Size (km ²)	Notes
River Blythe	The route will cross the River Blythe 400m north of Patrick Bridge. The closest point 90m from Scheme.	Main	GB 104028042572 Moderate	Good	Very high	0.076	Tame and Anker Mease	131	Flows northwards from 1.5km to the west of Balsall Common to 0.5km east of Hampton-in-Arden.
Shadow Brook	Flows in a north-eastwards direction, north of Hampton-in-Arden.	Main	No status shown in RBMP -assumed status Moderate	No status shown in RBMP -assumed status Good	Very high	0.001	Tame and Anker Mease	4.3	Tributary of the River Blythe and has its confluence with River Blythe near Diddington Hall.

¹ Environment Agency water-feature classification: *The Land Drainage Act 1991* defines an Ordinary watercourse as "A watercourse that is not part of a main river, all rivers and streams, ditches, drains, cuts, culverts, dikes, sluices, sewers (other than public sewers) and passages through which water flows". "Main Rivers" are larger rivers and streams designated by DEFRA, "Main Rivers" are regulated by the Environment Agency.

² *Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy.*

³ Year may vary in different RBMPs.

⁴ For examples of receptor value see Table 43 in the SMR Addendum (see Volume 5: CT-001-000/2).

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Water feature	Location description	Watercourse classification ¹	Water Framework Directive ² (WFD) water body and overall status	WFD status objective (by 2027 ³) as per river basin management plan (RBMP)	Receptor value ⁴	Q95 (m ³ /s)	Catchment/s	Size (km ²)	Notes
Bayleys Brook	East of Balsall Common and flows north-west parallel to A452 Kenilworth Road.	Ordinary	No status shown in RBMP -assumed status Moderate	No status shown in RBMP -assumed status Good	Very high	N/A	Tame and Anker Mease	11.3	A Tributary of the River Blythe and has its confluence with the River Blythe south-east of Hampton-in-Arden.
Horn Brook, River Blythe Tributary	Originates east of the A452 Kenilworth Road 300m west of Hornbook Farm.	Ordinary watercourse	No status shown in RBMP -assumed status Moderate	No status shown in RBMP -assumed status Good potential	Very high	N/A	Tame and Anker Mease	7.54	This channel then diverges immediately downstream of the A452 Kenilworth Road with the majority of flow being conveyed by the northern channel towards the B4102 Meriden Road.
Unnamed Watercourse	Located approximately 570m west of the route at Blythe Prior.	Ordinary watercourse	No status shown in RBMP -assumed status Moderate	No status shown in RBMP -assumed status Good	Very high	N/A	Tame and Anker Mease	N/A	Possibly linked to the River Blythe.
Unnamed pond	Approximately 50m west of the route and 70m north of disused pit.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated pond with no obvious links shown on the mapping to the adjacent stream, a tributary to the River Blythe.

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Water feature	Location description	Watercourse classification ¹	Water Framework Directive ² (WFD) water body and overall status	WFD status objective (by 2027 ³) as per river basin management plan (RBMP)	Receptor value ⁴	Q95 (m ³ /s)	Catchment/s	Size (km ²)	Notes
Unnamed Watercourse	Flows to lake along the eastern side of the route. At the closest point it is approximately 30m from the route.	Ordinary watercourse	No status shown in RBMP -assumed status Moderate	No status shown in RBMP -assumed status Good	Very high	N/A	Tame and Anker Mease	N/A	Potentially linked to the River Blythe SSSI.
Lavender Hall Fishery	Located north-east of Balsall Common.	Not applicable	Not applicable	Not applicable	Very High	N/A	Tame and Anker Mease	N/A	The fishery gains some of its water from a private borehole abstraction, and does not abstract water from the Bayleys Brook. The ponds are located hydraulically above the watercourse and discharge to the watercourse only when excess water is present in the ponds.
lake	Approximately 570m east of the route.	Not applicable	Not applicable	Not applicable	Very high	N/A	Tame and Anker Mease	N/A	Within River Blythe catchment, potentially linked to the River Blythe

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Water feature	Location description	Watercourse classification ¹	Water Framework Directive ² (WFD) water body and overall status	WFD status objective (by 2027 ³) as per river basin management plan (RBMP)	Receptor value ⁴	Q95 (m ³ /s)	Catchment/s	Size (km ²)	Notes
Molands Mere Lake	Approximately 940m east of the route, part of the Packington Somers Fisheries.	Not applicable	Not applicable	Not applicable	Very high	N/A	Tame and Anker Mease	N/A	Located adjacent to the River Blythe.
Siblings Lake	Approximately 860m east of the route, part of the Packington Somers Fisheries.	Not applicable	Not applicable	Not applicable	Very high	N/A	Tame and Anker Mease	N/A	Located adjacent to the River Blythe.
Geary's Lake	Approximately 800m east of the route, part of the Packington Somers Fisheries.	Not applicable	Not applicable	Not applicable	Very high	N/A	Tame and Anker Mease	N/A	Located adjacent to the River Blythe.
Anniversaries Lake	Approximately 780m east of the route, part of the Packington Somers Fisheries.	Not applicable	Not applicable	Not applicable	Very high	N/A	Tame and Anker Mease	N/A	Located adjacent to the River Blythe.

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Water feature	Location description	Watercourse classification ¹	Water Framework Directive ² (WFD) water body and overall status	WFD status objective (by 2027 ³) as per river basin management plan (RBMP)	Receptor value ⁴	Q95 (m ³ /s)	Catchment/s	Size (km ²)	Notes
Pond	Approximately 460m west of the route near Manor Nurseries.	Not applicable	Not applicable	Not applicable	Very high	N/A	Tame and Anker Mease	N/A	Located adjacent to the River Blythe.
Pond	Approximately 400m west of the route near Manor Nurseries.	Not applicable	Not applicable	Not applicable	Very high	N/A	Tame and Anker Mease	N/A	Located adjacent to the River Blythe.
Pond	Approximately 320 west of the route near Manor Nurseries.	Not applicable	Not applicable	Not applicable	Very high	N/A	Tame and Anker Mease	N/A	Located adjacent to the River Blythe.
Pond	Approximately 550m west of the route near Bilbury House.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 190m west of the route in Hampton-in-Arden.	Not applicable	Not applicable	Not applicable	Very high	N/A	Tame and Anker Mease	N/A	Located adjacent to the River Blythe.
Pond	Approximately 480m west of the route in Hampton-in-Arden.	Not applicable	Not applicable	Not applicable	Very high	N/A	Tame and Anker Mease	N/A	Located adjacent to the River Blythe.

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Water feature	Location description	Watercourse classification ¹	Water Framework Directive ² (WFD) water body and overall status	WFD status objective (by 2027 ³) as per river basin management plan (RBMP)	Receptor value ⁴	Q95 (m ³ /s)	Catchment/s	Size (km ²)	Notes
Pond	Approximately 315m west of the route in Hampton-in-Arden.	Not applicable	Not applicable	Not applicable	Very high	N/A	Tame and Anker Mease	N/A	Located adjacent to the River Blythe.
Pond	Approximately 845m west of the route and 300m south of Bradnocks Marsh.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 960m west of the route.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	860m west of the route at the Coast House.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 365m west of the route at New Mercote Farm.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no link to watercourses in the catchment.
Pond	Approximately 635m west of the route at Trevallion Stud.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.

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Water feature	Location description	Watercourse classification ¹	Water Framework Directive ² (WFD) water body and overall status	WFD status objective (by 2027 ³) as per river basin management plan (RBMP)	Receptor value ⁴	Q95 (m ³ /s)	Catchment/s	Size (km ²)	Notes
Pond	Approximately 750m west of the route at Trevallion Stud.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 850m west of the route near No. 32 Wootton Green Lane.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 970m west of the route and 448m north-east of Grange Farm.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 975m west of the route 448m north-east of Grange Farm.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 920m south-west of the route and 505m north-east of Grange Farm.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.

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Pond	Approximately 930m south-west of the route and 515m north-east of Grange Farm.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 910m south-west of route and 526m north-east of Grange Farm.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 965m south-west of the route and 468m east of Grange Farm.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 275m west of the route and 20m west of Hallmeadow Road.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.

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Pond	Approximately 350m south-west of the route and 100m east of Mews Cottage.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 415m south-west of the route and 902m south-east of Mews Cottage.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 280m south-west of the route and 200m of the dismantled railway.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 490m south-west of the route at 14 Beverley Close.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.

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Pond	Approximately 465m south-west of the route and 954m east of Sunnyside Farm.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 510m west of route at 17 Beverley Close.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 350m west of the route and north-west of Brickmakers Arms.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 430m east of route and 920m north of Mercote Hill Farm.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 595m east of route and 240m north-west of Mill Covert.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.

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Pond	Approximately 725m east of route near Mill Covert.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 755m east of the route near Mill Covert.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 860m east of the route near Mill Covert.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 780m east of the route near Mill Covert.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 900m east of the route near Mill Covert.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 595m east of the route near Mill Covert.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.

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Pond	Approximately 30m east of the route at Sixteen Acre Wood.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 105m east of the route and 30m west of Baulk Lane.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 40m east of the route and 80m west of Baulk Lane.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 15m west of the route and 130m north of Berkswell station.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Isolated field pond with no obvious link to watercourses in the catchment.
Pond	Approximately 410m east of the route south of The Island Project School.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	Located adjacent to Shadow Brook.

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Water feature	Location description	Watercourse classification ¹	Water Framework Directive ² (WFD) water body and overall status	WFD status objective (by 2027 ³) as per river basin management plan (RBMP)	Receptor value ⁴	Q95 (m ³ /s)	Catchment/s	Size (km ²)	Notes
Drain	Approximately 80m east of the route and west of Meriden Mill Farm.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	River Blythe catchment.
Drain	Approximately 605m east of the route and 170m south of Hornbrook Farm.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	River Blythe catchment
Drain	Approximately 405m east of the route and 255m south-west of Hornbrook Farm.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	River Blythe catchment
Drain	Approximately 425m east of the route at the Bogs.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	River Blythe catchment
Drain	Approximately 455m east of the route at the Bogs.	Not applicable	Not applicable	Not applicable	Low	N/A	Tame and Anker Mease	N/A	River Blythe catchment

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Drain	Approximately 575m east of the route at the Bogs.	Not applicable	Not applicable	not applicable	Low	N/A	Tame and Anker Mease	N/A	River Blythe catchment

3.2.6 There are no licensed surface water abstractions within 1km of the route.

3.2.7 Table 2 summarises surface water discharge consents within 1km of the route.

Table 2: Surface water discharge consents

Permit identifier	Distance from route (m)	Discharge type	Receiving water body
T/11/02762/S/1	At Molands Bridge approximately 635m east of the route.	Sewage treatment works (stw) - Final Effluent	River Blythe
S/11/26474/S	At Leafy approximately 695m east of the route.	Sewage discharges - final/treated effluent - not water company	Unnamed tributary of River Stowe
T/11/36200/S	At Beanit Cottage, Hob Lane, approximately 910m south-west of the route.	Sewage discharges - final/treated effluent - not water company	Tributary of River Blythe

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Permit identifier	Distance from route (m)	Discharge type	Receiving water body
T/11/36086/S	Near ponds at Brooklands Farm approximately 1km west of the route.	Sewage discharges - final/treated effluent - not water company	Unnamed Tributary of River Blythe
T/11/03628/S /1	Approximately 100m north-west of the route and 390m west of Ram hall.	Sewage treatment works - final effluent	River Blythe
T/11/03372/S/1	By the River Blyth, approximately 665m east of the route.	Sewage treatment works - final effluent	River Blythe
T/11/02536/S	Approximately 285m south-west of the route and 435m north-west of Little Poor Woods.	Sewage discharges - final/treated effluent - not water company	Tributary of River Blythe
T/11/03277/S	At Lincoln Farm Café, approximately 335m west of the route.	Sewage discharges - final/treated effluent - not water company	Tributary of River Blythe

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Permit identifier	Distance from route (m)	Discharge type	Receiving water body
T/11/22710/R	Approximately 875m west of the route and 80m from The Well House.	Sewage discharges - final/treated effluent - not water company	Tributary of Berkswell Brook
T/11/35795/Sg	At South Wing, Wootton Grange, approximately 845m west of the route.	Sewage discharges - final/treated effluent - not water company	Land (soakaway)
T/11/02640/O	At Dene House, approximately 820m north-east of the route.	Public sewage: storm sewage overflow	Berkswell Brook
T/11/03274/S	Approximately 500m west of the route near Mercote Hill Farm.	Sewage discharges - final/treated effluent - not water company	Tributary of River Blythe
T/11/03276/S	Near The Hollies, approximately 460m south-west of the route.	Sewage discharges - final/treated effluent - not water company	Tributary of River Blythe
T/11/01929/S/1	At Corry Farm, approximately 395m west of the route.	Sewage treatment works - final effluent	Berkswell Brook

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Permit identifier	Distance from route (m)	Discharge type	Receiving water body
T/11/35957/O	At Carol House, approximately 650m north-west of the route.	Public sewage: storm sewage overflow	Carol Green Brook
3/28/11/1658/1	At Truggist Hill, approximately 365m east of the route.	Sewage effluent	Unknown
T/15/35068/S	At Bayleys Brook, approximately 240m east of the route.	Sewage discharges - final/treated effluent - not water company	Tributary of Berkswell Brook
3/28/11/2049	At Mouldings Green Farm, approximately 540m east of the route.	Sewage discharges - final/treated effluent - not water company	Underground Strata
T/11/22215/S/1	The Stables, approximately 915m east of the route.	Sewage treatment works - final effluent	Berkswell Brook
T/11/03631/S	Approximately 840m east of the route and 195m south-west of Park Farm.	Sewage discharges - final/treated effluent - not water company	Tributary of River Blythe

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Permit identifier	Distance from route (m)	Discharge type	Receiving water body
T/11/35941/R	Approximately 810m east of the route and 80m south-west of The Well House.	Sewage discharges - stw storm overflow/storm tank - water company	Tributary of Berkswell Brook
T/11/35941/R	Approximately 970m east of the route and 109m south-west of The Well House.	Sewage discharges - stw storm overflow/storm tank - water company	Tributary of Berkswell Brook
T/11/36087/S	Near Ponds at Brooklands Farm approximately 1km west of the route.	Sewage discharges - final/treated effluent - not water company	Unnamed Tributary of River Blythe
Tsc1272	At River Blythe, approximately 225m west of the route.	Public sewage: storm sewage overflow	River Blythe
T/11/03660/O	At pond approximately 125m south-west of the route and approximately 60m north-west of Berkswell Station.	Sewage discharges - pumping station - water company	Tributary of the River Blythe

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Permit identifier	Distance from route (m)	Discharge type	Receiving water body
Npswqd007964	Near the Hobgoblins, approximately 980m south-west of the route.	Sewage discharges - final/treated effluent - not water company	Tributary of the River Blythe
T/11/35957/O	Near Carol Lodge, approximately 645m from the route.	Sewage discharges - pumping station - water company	Carol Green Brook
T/11/35941/R	Approximately 990m west of the route and 102m south-west of the Well House, Berkswell.	Sewage discharges - final/treated effluent - water company	Tributary of Berkswell Brook
T/11/35110/S	The Stables, approximately 915m east of the route.	Sewage discharges - final/treated effluent – not water company	Tributary of River Blythe
T/11/10976/S	Approximately 890m east of the route and approximately 140m south-east of Hill Farm.	Sewage discharges - final/treated effluent – not water company	Tributary of Long Brook and Tributary of River Blythe

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Permit identifier	Distance from route (m)	Discharge type	Receiving water body
T/11/35398/S	Approximately 425m east of the route and approximately 75m south of The Island Project School.	Sewage discharges - final/treated effluent – not water company	Shadow Brook
T/11/35941/R	Approximately 990m west of the route and approximately 100m south-west of the Well House, Berkswell.	Sewage discharges - final/treated effluent – not water company	Tributary of Berkswell Brook
T/11/35522/T	Approximately 590m west of the route and approximately 95m south-west of Solihull Garden Centre.	Sewage and trade combined - unspecified	Tributary of River Blythe
Npswqdo10654	Approximately 520m east of the route and approximately 85m south-west of Bramley Cottage.	Sewage discharges - final/treated effluent – not water company	Tributary of River Blythe

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Permit identifier	Distance from route (m)	Discharge type	Receiving water body
T/11/35941/R	Approximately 990m west of the route and approximately 100m south-west of the Well House, Berkswell.	Sewage discharges - stw storm overflow/storm tank - water company	Tributary of Berkswell Brook
T/11/35941/R	Approximately 995m west of the route and approximately 90m south-west of the Well House, Berkswell.	Discharge of other matter-crude effluent	Tributary of Berkswell Brook
T/11/35961/S	Approximately 220m east of the route and approximately 30m east of Baulk Lane.	Sewage discharges - final/treated effluent – not water company	Tributary of Berkswell Brook and Tributary of River Blythe
T/11/03560/S/1	Approximately 210m west of the route and approximately 55m north of Marsh Cottage.	Sewage treatment works - final effluent	River Blythe
3/28/11/0813/1	At Ram Hall, approximately 620m east of the route and	Sewage effluent	Unknown

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Permit identifier	Distance from route (m)	Discharge type	Receiving water body
T/01/03538/S/1	Final Home, approximately 145m west of the route.	Sewage treatment works - final effluent	Bradnock Brook
Npswqd005997	Approximately 545m west of the route and approximately 165m east of Bilbury House.	Sewage discharges - final/treated effluent – not water company	Ditch of the River Blythe
T/11/02501/O	Approximately 95m south of Meriden Road and approximately 265m west of the route	Sewage discharges - pumping station - water company	Tributary of River Blythe
CT/15/35068/S/1	At Bayleys Brook, approximately 275m east of the route.	Sewage treatment works - final effluent	Yewtree Farm Book
T/11/35941/R	Approximately 990m west of the route and 100m south-west of the Well House, Berkswell.	Sewage discharges - final/treated effluent - water Company	Tributary of Berkswell Brook

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Permit identifier	Distance from route (m)	Discharge type	Receiving water body
T/11/09245/T	At Pond, approximately 555m east of the route and 275m south of Hornbrook Farm.	Trade discharge - mineral workings	Tributary of Horn Brook
T/11/36480/S	Near Hollybush on Bradnocks Lane, approximately 740m west of the route.	Sewage discharges - final/treated effluent – not water company	Unnamed Tributary of River Blythe
T/11/35941/R	Approximately 995m west of the route and approximately 90m south-west of the Well House, Berkswell.	Sewage discharges - final/treated effluent - water company	Tributary of Berkswell Brook
T/11/35941/R	Approximately 990m west of the route and approximately 100m south-west of the Well House Berkswell.	Sewage discharges - stw storm overflow/storm tank - water company	Tributary of Berkswell Brook

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Permit identifier	Distance from route (m)	Discharge type	Receiving water body
T/11/03727/S	At A452 Kenilworth Road/A45 Coventry Road (Stonebridge Island), approximately 610m east of the route.	Sewage discharges - final/treated effluent - not water company	River Blythe
T/11/03485/O	Rear 3 Nesfield Crescent, approximately 670m west of the route.	Public sewage: storm sewage overflow	Tributary of River Blythe
T/11/03371/S	Approximately 355m east of the route and 110m of The island Project School.	Sewage discharges - final/treated effluent - not water company	River Blythe
T/11/20529/O	Near Carol House, approximately 650m north-east of the route.	Public sewage: storm sewage overflow	Carol Green Brook

3.3 Groundwater

3.3.1 Baseline information is shown on Volume 5: Map WR-02-023.

- 3.3.2 Superficial glacial deposits are present within much of the study area. Most of the glacial deposits that will be beneath the route are sands and gravels, which form an extensive but now dissected deposit beneath the axis of the River Blythe valley and form a significant local aggregate resource. Fluvial and alluvial deposits are present across the lower parts of the river and stream valleys within this section of the route.
- 3.3.3 The underlying solid geology upper strata within the study area consist of the Carboniferous Warwickshire Group. These comprise the Tile Hill Mudstone Formation, which is made up of red and brown blocky mudstone and laminated siltstone. Mercia Mudstone is also present. Within the Mercia Mudstone sequence, in the Knowle Basin, a thicker horizon of interbedded sandstone, siltstone and mudstone, known as the Arden Sandstone Member occurs. The geology of the area is presented in Volume 5: Map WR-02 -023.
- 3.3.4 Three categories of aquifer have been identified within the study area:
- the Tile Hill Mudstones is a formation of the Upper Carboniferous Westphalian Unit, which is classified as a Principal aquifer;
 - the glacio-fluvial deposits, river deposits, alluvium and Arden Sandstone are a Secondary A aquifer; and
 - the Mercia Mudstone is a Secondary B aquifer.
- 3.3.5 Groundwater is expected to be shallow and present within the superficial deposits across this study area. The Mercia Mudstone Group is water-bearing in places by virtue of the siltstones and sandstones of the skerries and the Arden Sandstones.
- 3.3.6 There are no groundwater source protection zones (SPZ) located within the study area. There is one licensed groundwater abstraction in the area and three unlicensed groundwater abstractions refer to Table 3.
- 3.3.7 Table 3 summarises licensed groundwater abstractions within 1km of the route (see Volume 5: Map WR-02 -023).

Table 3: Licensed groundwater abstractions

Permit Identifier (map reference)	Distance from route (m)	Abstraction horizon	Max annual abstraction quantity (m ³ /yr)	Max daily abstraction quantity (m ³ /d)	Number of boreholes
03/28/11/0132 03/28/11/0133 (Berkswell Quarry)	Approximately 480m north-east of route	Secondary aquifer (Mercia Mudstones)	Unknown	Unknown	Unknown

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No map reference					
Silver Birch (unlicensed)	Approximately 220m south-west of route	Unknown	Unknown	Unknown	Unknown
The Cottage (unlicensed) Map reference - GWUA - 2	Approximately 750m south-west of route	Unknown	Unknown	Unknown	Unknown
Lavender Hall (unlicensed) Map reference - GWUA - 3	Approximately 135m south-west of route	Unknown	Unknown	Unknown	Unknown

3.3.8 Table 4 summarises groundwater discharge consents within 1km of the route.

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Table 4: Groundwater discharge consents

Permit Identifier (map reference no)	Distance from route (m)	Discharge type	Receiving water body
WQ/72/3643/1 Two Oaks, Red Lane, No map reference	Approximately 180m south- south-west of route	Sewerage discharge (sewage effluent)	Groundwater
3/28/11/1658/1 Frogmore, St Helen's Road, Solihull No map reference	Approximately 250m north- north-west of route	Sewerage discharge (sewage effluent)	Groundwater
3/28/11/1104/1 Proposed new dwelling, Truggist Lane, Berkswell No map reference	Approximately 60m north-east of route	Sewerage discharge (sewage effluent)	Groundwater
3/28/11/0813/1 Ram Hall Farm, Baulks Lane, Berkswell No map reference	Approximately 520m north-east of route	Sewerage discharge (sewage effluent)	Groundwater
3/28/11/1366/1 Lavender Hall Farm, Lavender Hall Lane, Berkswell No map reference	Approximately 35m south-west of route	Sewerage discharge (sewage effluent)	Groundwater
3/28/11/2359/1 The Croft, Wootton Lane, Berkswell No map reference	Approximately 520m south- west of route	Sewerage discharge (sewage effluent)	Groundwater

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Permit Identifier (map reference no)	Distance from route (m)	Discharge type	Receiving water body
T/11/14160/TG/1 New proposed dog kennels, Four Winds Cottage, Kenilworth Road, Hampton-in-Arden No map reference	Approximately 160m south-west of route	Trade discharge (trade effluent)	Groundwater
T/11/35795/Sg Wootton Grange, Wootton Green Lane, Balsall Common No map reference	Approximately 770m south-west of route	Sewerage discharge (final/ treated effluent)	Land/soakaway
3/28/11/2458/1 Meriden Mill Farmhouse, Stonebridge, Hampton-in-Arden No map reference	Approximately 540m east-north-east of route	Sewerage discharge (sewage effluent)	Groundwater
3/28/11/2049 Mouldings Green Farm, Stonebridge, Hampton-in-Arden	Approximately 530m east of route	Sewerage discharge (final/ treated effluent)	Land/soakaway
WQ/72/1250/1 Garden Cottage, Marsh Lane, Hampton-in-Arden	Approximately 500m south-west of route	Sewerage discharge (sewage effluent)	Groundwater
Wq/72/128 The Cottage, Kenilworth Road, Hampton-in-Arden Volume 5: Map WR-02 -023	Approximately 440m south-west of route	Sewerage discharge (final/ treated effluent)	Land/soakaway

3.4 Groundwater/surface water interaction

3.4.1 Table 5 summarises groundwater/ surface water interactions within 1km of the route.

Table 5: Groundwater/surface water interaction

Location description	Distance from route (m)	Formation	Elevation(mAOD)	Comments
River Blythe	Generally more than 100 m west of the route except, where the route will cross the river on viaduct.	Permeable superficial deposits	Approximately 85	Site specific information on dependence is not available. Assumed connection though permeable superficial deposits ⁵ . Further pre-construction assessment required.
Beechwood Farm	Approximately 515m north east of route	Ardwick Group Barren Measures Red Measures (Bedrock)	115	Site specific information on dependence is not available. Assumed connection though permeable superficial deposits. Further pre-construction assessment required.
Bockendon Grange	Approximately 260m north east of route	Ardwick Group Barren Measures Red Measures (Bedrock)	100	Site specific information on dependence is not available. Assumed connection though permeable superficial deposits. Further pre-construction assessment required.
Catchems Corner	Approximately 650m south west of route	Lacustrine Deposits Clay (Superficial) and Triassic Rocks (undifferentiated) (Bedrock)	124	Site specific information on dependence is not available. Assumed connection though permeable superficial deposits. Further pre-construction assessment required.
Beanit Farm	Approximately 720m south west of route	Lacustrine Deposits Clay (Superficial_ and Ardwick Group Barren Measures red Measures (Bedrock)	130	Site specific information on dependence is not available. Assumed connection though permeable superficial deposits. Further pre-construction assessment

⁵ Knipe, C.V., Lloyd, J.W., Lerner, D.N. and Greswell, R. (1993), *Rising Groundwater levels in Birmingham and the engineering implications*, CIRIA Special Publication

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				required.
Wootton Green	Approximately 415m south west of route	Glacial Sand and Gravel (Superficial) and Triassic Rocks (undifferentiated) (Bedrock)	95	Site specific information on dependence is not available. Assumed connection though permeable superficial deposits. Further pre-construction assessment required.
Lower Farm	Approximately 650m north east of route	Ardwick Group Barren Measures red Measures (Bedrock)	115	Site specific information on dependence is not available. Assumed connection though permeable superficial deposits. Further pre-construction assessment required.
Bradnocks Farm	Approximately 490m south west of route	Glacial Sand and Gravel (Superficial) and Triassic Rocks (undifferentiated) (Bedrock)	100	Site specific information on dependence is not available. Assumed connection though permeable superficial deposits. Further pre-construction assessment required.
Hampton-in-Arden	Approximately 810m west of route	Triassic Rocks (undifferentiated)	103	Geological boundary between the Arden sandstone and Mercia Mudstone. Site specific information on dependence is not available. Assumed connection though permeable superficial deposits. Further pre-construction assessment required.

3.5 Water dependent habitats

3.5.1 Table 6 summarises the water dependent habitats within 1km of the route.

Table 6: Description of water dependent habitats

Location	Distance from route (m)	Designation	Comments
Berkswell Marsh SSSI	Ranging from approximately 20m to 500m north of the route	Fen meadow and wet woodland.	Site specific information on dependence is not available. Assumed connection though permeable superficial deposits. Impact assessment has confirmed not significant. See Section 4 of this report for further detail.
River Blythe SSSI	Generally more than 100 m west of the route except where the route will cross the river on viaduct.	Floodplain	Site specific information on dependence is not available. Assumed connection though permeable superficial deposits. Further assessment required prior to construction.
Patrick Farm Meadow and Mouldings Green Farm Meadow LWS	Route will cross and approximately 20m	Marshy grassland - groundwater floodplain	Site specific information on dependence is not available. Assumed connection though permeable superficial deposits. Further assessment required prior to construction.

4 Site specific assessments

4.1 Surface water

- 4.1.1 Table 7 summarises the potential impacts and effects to surface water. Table 7 only includes surface water features which could potentially be impacted by the Proposed Scheme. Features such as isolated ponds and drains which lie outside the land required for the Proposed Scheme are not included. However, details of the features are provided in Table 1. Where the ecology of water features will be impacted these are assessed and presented within the ecology assessment (see Volume 2, Section 7, CFA23).

Table 7: Summary of potential impacts to surface water

Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact effect	Other mitigation measures	Residual effect	Duration of effect
River Blythe and its tributaries	Very high	Rail and associated infrastructure	Potential impact on water quality and receiving watercourse flow from run-off from construction areas.	Minor adverse	Draft CoCP Section 16 regarding control of site drainage from earthworks and construction sites, and procedures to follow BS6031 Code of Practice for Earthworks ⁶ .	Negligible impact Neutral Effect (not significant)	None required	Negligible impact Neutral Effect (not significant)	Construction (temporary)

⁶ British Standards Institute (BSI) 6031-2009, *Code of Practice for Earthworks*, London.

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Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact effect	Other mitigation measures	Residual effect	Duration of effect
Bayleys Brook	Very high	Balsall Common viaduct	Potential impact on water quality and receiving watercourse flow from run-off from construction areas.	Minor adverse	Draft CoCP Section 16 'provision of a suitable construction site drainage system including cut-off ditches or drains and sustainable drainage systems, or equivalent, with suitably sized treatment facilities such as settlement or detention basins'; 'appropriate measures such as the use of bunds of non-erodible material or silt or sediment fences adjacent to watercourses'; and 'the good working practices detailed in the Environment Agency's Pollution Prevention Guidelines will be adopted', Temporary construction methods and CIRIA publications (including C532 ⁷ , C648 ⁸ and C649 ⁹).	Negligible impact Neutral Effect (not significant)	None required	Negligible impact Neutral Effect (not significant)	Construction (temporary)

⁷ Construction Industry Research and Information Association (CIRIA) C532 (2001), *Control of water pollution from construction sites*, CIRIA, London.

⁸ Construction Industry Research and Information Association (CIRIA) C643 (2005), *The potential for water pollution from railways*, CIRIA, London.

⁹ Construction Industry Research and Information Association (CIRIA) C649 (2006), *Control of water pollution from linear construction projects*, CIRIA, London.

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Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact effect	Other mitigation measures	Residual effect	Duration of effect
Tributaries to Bayleys Brook	Very high	Small watercourse culverts	Potential impact on water quality and receiving watercourse flow from run-off from construction areas.	Minor adverse	Draft CoCP Section 16 'provision of a suitable construction site drainage system including cut-off ditches or drains and sustainable drainage systems, or equivalent, with suitably sized treatment facilities such as settlement or detention basins' ; 'appropriate measures such as the use of bunds of non-erodable material or silt or sediment fences adjacent to watercourses'; and 'the good working practices detailed in the Environment Agency's Pollution Prevention Guidelines will be adopted', Temporary construction methods and CIRIA publications (including C532, C648 and C649).	Negligible impact Neutral Effect (not significant)	None required	Negligible impact Neutral Effect (not significant)	Construction (temporary)

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Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact effect	Other mitigation measures	Residual effect	Duration of effect
Bayleys Brook	Very high	Lavender Hall Lane overbridge and embankment	Potential impact on water quality and receiving watercourse flow from run-off from construction areas.	Minor adverse	Draft CoCP Section 16 regarding control of site drainage from earthworks and construction sites, and procedures to follow BS6031 Code of Practice for Earthworks.	Negligible impact Neutral Effect (not significant)	None required	Negligible impact Neutral Effect (not significant)	Construction (temporary)

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Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact effect	Other mitigation measures	Residual effect	Duration of effect
Bayleys Brook	Very high	Marsh Farm viaduct	Potential impact on water quality and receiving watercourse flow from run-off from construction areas.	Minor adverse	Draft CoCP Section 16 'provision of a suitable construction site drainage system including cut-off ditches or drains and sustainable drainage systems, or equivalent, with suitably sized treatment facilities such as settlement or detention basins'; 'appropriate measures such as the use of bunds of non-erodible material or silt or sediment fences adjacent to watercourses'; and 'the good working practices detailed in the Environment Agency's Pollution Prevention Guidelines will be adopted', Temporary construction methods and CIRIA publications (including C532, C648 and C649).	Negligible impact Neutral Effect (not significant)	None required	Negligible impact Neutral Effect (not significant)	Construction (temporary)

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Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact effect	Other mitigation measures	Residual effect	Duration of effect
River Blythe	Very high	River Blythe Bypass culvert	Potential impact on water quality and receiving watercourse flow from run-off from construction areas.	Minor adverse	Draft CoCP Section 16 'provision of a suitable construction site drainage system including cut-off ditches or drains and sustainable drainage systems, or equivalent, with suitably sized treatment facilities such as settlement or detention basins'; 'appropriate measures such as the use of bunds of non-erodible material or silt or sediment fences adjacent to watercourses'; and 'the good working practices detailed in the Environment Agency's Pollution Prevention Guidelines will be adopted', Temporary construction methods and CIRIA publications (including C532, C648 and C649).	Negligible impact Neutral Effect (not significant)	None required	Negligible impact Neutral Effect (not significant)	Construction (temporary)

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Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact effect	Other mitigation measures	Residual effect	Duration of effect
River Blythe	Very high	River Blythe viaduct	Potential impact on water quality and receiving watercourse flow from run-off from construction areas.	Minor adverse	Draft CoCP Section 16 'provision of a suitable construction site drainage system including cut-off ditches or drains and sustainable drainage systems, or equivalent, with suitably sized treatment facilities such as settlement or detention basins'; 'appropriate measures such as the use of bunds of non-erodible material or silt or sediment fences adjacent to watercourses'; and 'the good working practices detailed in the Environment Agency's Pollution Prevention Guidelines will be adopted', Temporary construction methods and CIRIA publications (including C532, C648 and C649).	Negligible impact Neutral Effect (not significant)	None required	Negligible impact Neutral Effect (not significant)	Construction (temporary)

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Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact effect	Other mitigation measures	Residual effect	Duration of effect
Shadow Brook	Very high	Shadow Brook underpass, and new footpath/bridleway over brook.	Potential impact on water quality and receiving watercourse flow from run-off from construction areas.	Minor adverse	Draft CoCP Section 16 'provision of a suitable construction site drainage system including cut-off ditches or drains and sustainable drainage systems, or equivalent, with suitably sized treatment facilities such as settlement or detention basins'; 'appropriate measures such as the use of bunds of non-erodible material or silt or sediment fences adjacent to watercourses'; and 'the good working practices detailed in the Environment Agency's Pollution Prevention Guidelines will be adopted', Temporary construction methods and CIRIA publications (including C532, C648 and C649).	Negligible impact Neutral Effect (not significant)	None required	Negligible impact Neutral Effect (not significant)	Construction (temporary)

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Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact effect	Other mitigation measures	Residual effect	Duration of effect
River Blythe		Various embankments and cuttings, construction of viaducts.	Potential impact on water quality and receiving watercourse flow from run-off from construction areas.	Minor adverse	Draft CoCP Section 16 regarding control of site drainage from earthworks and construction sites, and procedures to follow BS6031 Code of Practice for Earthworks.	Negligible impact Neutral Effect (not significant)	None required	Negligible impact Neutral Effect (not significant)	Construction (temporary)
		Realignment of Bayleys Brook under the viaduct.	Potential for increased flood risk by inadvertently displacing floodwaters.	Minor adverse	Draft CoCP Section 16 'the good working practices detailed in the Environment Agency's Pollution Prevention Guidelines will be adopted', Temporary construction methods and CIRIA publications (including C532, C648 and C649).	Negligible impact Neutral Effect (not significant)	None required	Negligible impact Neutral Effect (not significant)	Construction (temporary)
River Blythe floodplain	High	Construction phase activities within flood plain.	Potential for increased flood risk by inadvertently displacing floodwaters.	Minor adverse	Draft CoCP Section 16 state that construction activities will be undertaken having regard to the requirements to avoid increasing flood risk. This will include preparation of site specific flood risk management plans for those areas of the site at risk of flooding.	Negligible impact Neutral Effect (not significant)	None required	Negligible impact Neutral Effect (not significant)	Construction (temporary)

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Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact effect	Other mitigation measures	Residual effect	Duration of effect
Isolated ponds	Low	Rail and associated infrastructure	Pond located within construction footprint, may be lost during construction	Moderate adverse	Any pond with significant ecological value will be mitigated. These are assessed and presented within the ecology assessment (see Volume 2, Section 7, CFA23)	Negligible impact Neutral Effect (not significant)	None required	Negligible impact Neutral Effect (not significant)	Construction (permanent)
Bayleys Brook	Very high	Routine drainage from track infrastructure	Potential for reduction in water quality from track drainage.	Minor adverse	Balancing ponds will be located adjacent to the route at Beechwood embankment and Truggist Lane. These will discharge to the Bayleys Brook and will improve the quality of track drainage water discharging into the brook and River Blythe catchment.	Negligible impact Neutral Effect (not significant)	None required	Negligible impact Neutral Effect (not significant)	Permanent
Tributary of River Blythe at Berkswell Marsh SSSI	Very high	Routine drainage from track infrastructure	Potential for reduction in water quality from track drainage.	Minor adverse	Balancing pond will be located adjacent to the route near Marsh Farm. This will discharge to the tributary and will improve the quality of track drainage water released into the River Blythe.	Negligible impact Neutral Effect (not significant)	None required	Negligible impact Neutral Effect (not significant)	Permanent

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Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact effect	Other mitigation measures	Residual effect	Duration of effect
River Blythe	Very high	Routine drainage from track infrastructure	Potential for reduction in water quality from track drainage.	Minor adverse	Balancing ponds will be located adjacent to the route near the Blythe Bypass embankment and the Patrick cutting. These will discharge to the River Blythe and will improve the quality of track drainage water discharging into the river.	Negligible impact Neutral Effect (not significant)	None required	Negligible impact Neutral Effect (not significant)	Permanent
Shadow Brook	Very high	Routine drainage from track infrastructure	Potential for reduction in water quality from track drainage.	Minor adverse	Balancing ponds will be located adjacent to the route near the Diddington Lane embankment either side of Shadow Brook. These will discharge to the Shadow Brook and will improve the quality of track drainage water released into the River Blythe.	Negligible impact Neutral Effect (not significant)	None required	Negligible impact Neutral Effect (not significant)	Permanent

4.3 Groundwater

4.3.1 Table 8: summarises the potential impacts to groundwater, abstractions, groundwater-dependent terrestrial ecosystems (GWDTE) and groundwater/ surface water interactions.

Table 8: Summary of potential impacts to groundwater, abstractions, GWDTE and groundwater/ surface water interactions

Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual Effect	Duration of effect
Berkswell Marsh SSSI	Very high	Cutting between Lavender Hall Lane and Sixteen Acre Wood.	Temporary dewatering affecting groundwater levels and quality.	Negligible (Not significant)	Draft CoCP Section 16 concerning waste water and groundwater best practice measures. Remove or breakthrough cut-off structures following construction, incorporate passive bypasses within the design, incorporate collars in these passive bypasses to avoid creating artificial flow paths, implement a regime of post construction monitoring of groundwater levels.	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (temporary)

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Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual Effect	Duration of effect
		'Dig out and replace' near the proposed Marsh Farm viaduct.		Negligible (Not significant)	Draft CoCP Section 16, as above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (temporary)
		'Dig out and replace' near the proposed River Blythe Bypass culvert.		Negligible (Not significant)	Draft CoCP Section 16, as above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (temporary)
		All below ground construction sites and structures e.g. piling for Sixteen Acre Wood bridge and Marsh Farm viaduct.	Barriers of low permeability affecting groundwater levels and quality.	Negligible (Not significant)	Draft CoCP Section 16, as above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (temporary)

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Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual Effect	Duration of effect
River Blythe SSSI/ River Blythe	Very high	Cuttings at B4102 Meriden Road and at Marsh Lane.	Temporary dewatering affecting groundwater levels and quality.	Minor adverse (Significant)	Draft CoCP Section 16, as above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (temporary)
		'Dig out and replace' near the proposed Marsh Farm viaduct.		Minor adverse (Significant)	Draft CoCP Section 16, as above	Negligible impact Neutral effect (Not significant)		Negligible impact Neutral effect (Not significant)	Construction (temporary)
		'Dig out and replace' near the proposed River Blythe Bypass Underbridge and between the proposed River Blythe Bypass culvert.		Minor adverse (Significant)	Draft CoCP Section 16, as above	Negligible impact Neutral effect (Not significant)		Negligible impact Neutral effect (Not significant)	Construction (temporary)

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Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual Effect	Duration of effect
		'Dig out and replace' near the proposed Marsh Farm viaduct.		Minor adverse (Significant)	Draft CoCP Section 16 as above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (temporary)
		All below ground construction sites and structures e.g. piling for River Blythe viaduct and River Blythe bypass underbridge.	Barriers of low permeability affecting groundwater levels and quality.	Minor adverse (Significant)	Draft CoCP Section 16, as above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (temporary)
Tile Hill Mudstone	High	All below ground construction sites and structures e.g. piling for Carol Green Rail underbridge and Balsall Common viaduct.	Barriers of low permeability affecting groundwater levels and quality.	Minor adverse (Significant)	Draft CoCP Section 16, as above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (temporary)

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Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual Effect	Duration of effect
Permeable Superficial Deposits and Mercia Mudstone/ Springs	Moderate	Cutting between Lavender Hall Lane and Sixteen Acre Wood.	Temporary dewatering affecting groundwater levels and quality.	Minor adverse (Not significant)	Draft CoCP Section 16, as above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (temporary)
		Cutting at B4102 Meriden Road	Temporary dewatering affecting groundwater levels and quality.	Minor adverse (Not significant)	Draft CoCP Section 16, as above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (temporary)
		Cutting at Marsh Lane	Temporary dewatering affecting groundwater levels and quality.	Minor adverse (Not significant)	Draft CoCP Section 16, as above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (temporary)
		Areas of 'dig out and replace'		Minor adverse (Not significant)	Draft CoCP Section 16, as above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (temporary)

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Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual Effect	Duration of effect
		All below ground construction sites and structures e.g. piling for Heart of England Way Bridge and Sixteen Acre Wood bridge.	Barriers of low permeability affecting groundwater levels and quality.	Minor adverse (Not significant)	Draft CoCP Section 16, as above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (temporary)
Groundwater user - private groundwater user at Silver Birch	High	Cutting between Lavender Hall Lane and Sixteen Acre Wood.	Temporary dewatering affecting groundwater levels and quality.	Minor adverse (Significant)	Draft CoCP Section 16, as above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (temporary)
		All below ground construction sites and structures e.g. piling for Sixteen Acre Wood bridge.	Barriers of low permeability affecting groundwater levels and quality.	Minor adverse (Significant)	Draft CoCP Section 16, as above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (temporary)

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Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual Effect	Duration of effect
Groundwater user - Berkswell Quarry	High	Area of 'dig out and replace' near the proposed River Blythe Bypass culvert.	Temporary dewatering affecting groundwater levels and quality	Minor adverse (Significant)	Draft CoCP Section 16, as above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (temporary)
		All below ground construction sites and structures e.g. Marsh Farm viaduct.	Barriers of low permeability affecting groundwater levels and quality.	Minor adverse (Significant)	Draft CoCP Section 16, as above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (temporary)
Groundwater users - The Cottage and Lavender Hall	High	The groundwater users are >1km from areas of excavation and below ground structures.	Unlikely to be an impact to groundwater quantity and quality at abstraction.	Negligible (Not significant)	Draft CoCP Section 16, as above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (temporary)

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Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual Effect	Duration of effect
Patrick Farm Meadow and Mouldings Green Farm LWS	Low	Diddington cutting	Temporary dewatering affecting groundwater levels and quality.	Negligible (Not significant)	Draft CoCP Section 16, as above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (temporary)
		Areas of 'dig and replace'		Negligible (Not significant)	Draft CoCP Section 16, as above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (temporary)
		All below ground construction sites and structures e.g. piling for A542 Kenilworth Road overbridge.	Barriers of low permeability affecting groundwater levels and quality.	Negligible (Not significant)	Draft CoCP Section 16, as above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (temporary)

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Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual Effect	Duration of effect
Berkswell Marsh SSSI	Very high	Cutting between Lavender Hall Lane and Sixteen Acre Wood.	Permanent groundwater control affecting groundwater levels and quality.	Minor adverse (Significant)	Remove or breakthrough cut-off structures following construction, incorporate passive bypasses within the design, incorporate collars in these passive bypasses to avoid creating artificial flow paths, implement a regime of post construction monitoring of groundwater levels.	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (permanent)
		All below ground construction sites and structures e.g. piling for Sixteen Acre Wood bridge and Marsh Farm viaduct.	Barriers of low permeability affecting groundwater levels.	Minor adverse (Significant)	As above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (permanent)

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Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual Effect	Duration of effect
River Blythe SSSI/ River Blythe	Very high	Cuttings at B4102 Meriden Road and at Marsh Lane.	Permanent groundwater control affecting groundwater levels and quality.	Minor adverse (Significant)	As above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (permanent)
		All below ground construction sites and structures e.g. piling for River Blythe viaduct and River Blythe bypass underbridge.	Barriers of low permeability affecting groundwater levels.	Minor adverse (Significant)	As above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (permanent)
Tile Hill Mudstone	High	All below ground construction sites and structures e.g. piling for Carol Green Rail underbridge and Balsall Common viaduct.	Barriers of low permeability affecting groundwater levels.	Minor adverse (Significant)	As above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (permanent)

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Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual Effect	Duration of effect
Permeable Superficial Deposits and Mercia Mudstone/ Springs	Moderate	Cutting between Lavender Hall Lane and Sixteen Acre Wood.	Permanent groundwater control affecting groundwater levels.	Minor adverse (Not significant)	As above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (permanent)
		Cutting at B4102 Meriden Road.		Minor adverse (Not significant)	As above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (permanent)
		Cutting at Marsh Lane		Minor adverse (Not significant)	As above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (permanent)

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Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual Effect	Duration of effect
		All below ground construction sites and structures e.g. piling for Heart of England Way Bridge and Sixteen Acre Wood bridge.	Barriers of low permeability affecting groundwater levels.	Minor adverse (Not significant)	As above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (permanent)
Groundwater user - private groundwater user at Silver Birch	High	Cutting between Lavender Hall Lane and Sixteen Acre Wood.	Permanent groundwater control affecting groundwater levels.	Minor adverse (Significant)	As above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (permanent)
		All below ground construction sites and structures e.g. piling for Sixteen Acre Wood bridge.	Barriers of low permeability affecting groundwater levels.	Minor adverse (Significant)	As above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (permanent)

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Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual Effect	Duration of effect
Groundwater user - Berkswell Quarry	High	All below ground construction sites and structures e.g. Marsh Farm viaduct	Barriers of low permeability affecting groundwater levels.	Minor adverse (Significant)	As above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (permanent)
Groundwater users - The Cottage and Lavender Hall	High	All areas of excavation and below ground structures.	The groundwater users are >1km from areas of excavation and below ground structures. No impact is anticipated.	Negligible (Not significant)	As above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (permanent)
Patrick Farm Meadow and Mouldings Green Farm LWS	Low	Diddington cutting	Permanent groundwater control affecting groundwater levels.	Negligible (Not significant)	As above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (permanent)

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Water feature / receptor	Value of water feature	Design element	Potential impact to water receptor	Magnitude of potential impact (no mitigation)	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual Effect	Duration of effect
		All below ground construction sites and structures e.g. piling for A542 Kenilworth Road overbridge.	Barriers of low permeability affecting groundwater levels	Negligible (Not significant)	As above	Negligible impact Neutral effect (Not significant)	None required	Negligible impact Neutral effect (Not significant)	Construction (permanent)

4.4 Detailed assessment

Groundwater assessment of the cuttings/excavations

4.4.1 Table 9 summarises the excavations and the requirement for groundwater control. Only those impacts and effects that are classed as significant are presented in the Volume 2, Section 13.4. The route will cross the River Blythe SSSI floodplain on viaduct and will be on embankment either side of the floodplain. As such, the impacts of construction to the River Blythe SSSI within the floodplain to surface water, groundwater and flood risk are considered to be not significant, see Table 7 and Table 8.

Table 9: Summary of cuttings/excavations and requirement for groundwater control

Cutting name and depth	Geology penetrated	Groundwater elevation	Potential impact on groundwater resources	Mitigation	Residual Significance
Area of dig out and replace under Beechwood embankment.	Tile Hill Mudstone	Cutting above water strike	Interception of Tile Hill Mudstone groundwater unlikely.	Pre-construction monitoring to confirm If required, mitigation includes temporary and permanent groundwater control.	Not significant
Area of dig out and replace under embankment near Balsall Common viaduct.	Tile Hill Mudstone	Cutting above water strike	Interception of Tile Hill Mudstone groundwater unlikely.	Pre-construction monitoring to confirm If required, mitigation includes temporary and permanent groundwater control.	Not significant
Park Lane cutting.	Alluvium, Sand and Gravel over Mercia Mudstone.	Cutting below water strike	Interception of Alluvium and Sand and Gravel groundwater likely. However, cutting along surface water divide and no continuous pathway through superficial to Berkswell Marsh SSSI.	Pre-construction monitoring to confirm If required, mitigation includes temporary and permanent groundwater control.	Not significant

Berkswell Marsh SSSI Impact Assessment

- 4.4.2 An impact assessment of the route on Berkswell Marsh SSSI was undertaken. The closest construction element to the Berkswell Marsh SSSI will be the Park Lane cutting with an approximate length of 2.1km and maximum depth to 11.9 m below ground level (m bgl). The location of Berkswell Marsh in relation to the route is shown on Figure 1.
- 4.4.3 Berkswell Marsh is a SSSI notified under Section 28 of the Wildlife and Countryside Act 1981 as amended. Natural England also advises that the SSSI is partially dependent on groundwater contributions from the underlying glaciofluvial sand and gravel deposits.
- 4.4.4 A conceptual model of the site was prepared using available geology, hydrological and hydrogeological information, and the model was used to determine the likely impacts of the cutting on water flows to the Berkswell Marsh. The following summarises the conceptual model.
- 4.4.5 The main surface water features in the study area are the River Blythe, Bayleys Brook (tributary of the River Blythe) and associated tributaries and the Berkswell Estate fishing lake. Several streams flow into Bayleys Brook from the north and the east, upstream of the SSSI, corresponding with the Bromsgrove Sandstone Formation and Tile Hill Mudstone Formation geological outcrops. Several of these streams are shown originating as springs to the north-east of the river valley. There are no streams draining to Bayleys Brook from the Mercia Mudstone Group outcrop to the south. The Berkswell Estate fishing lake is located upstream of the SSSI and to the south-west of Berkswell Hall on the Berkswell Estate. The surface water features are shown on Figure 1.
- 4.4.6 Glacial sands and gravels occur within and on the flanks of the Bayleys Brook valley, and are overlain by fluvial and alluvial deposits within the base of the valley, including within Berkswell Marsh SSSI. They are largely continuous between the cutting and Berkswell Marsh SSSI.
- 4.4.7 Superficial deposits are absent along the lower valley flanks in the location of the fishing lake but occur on higher ground i.e. the superficial deposits are not continuous between the cutting and the lake. The lake is formed on an alluvium layer. The superficial geology is shown on Figure 1.
- 4.4.8 The solid geology of the study area comprises Mercia Mudstone Group, Bromsgrove Sandstone Formation and Tile Hill Mudstone Formation. The distribution of geology is shown in Figure 3. The geology key is shown in Figure 4.

Figure 1: Site location, surface water features and superficial geology

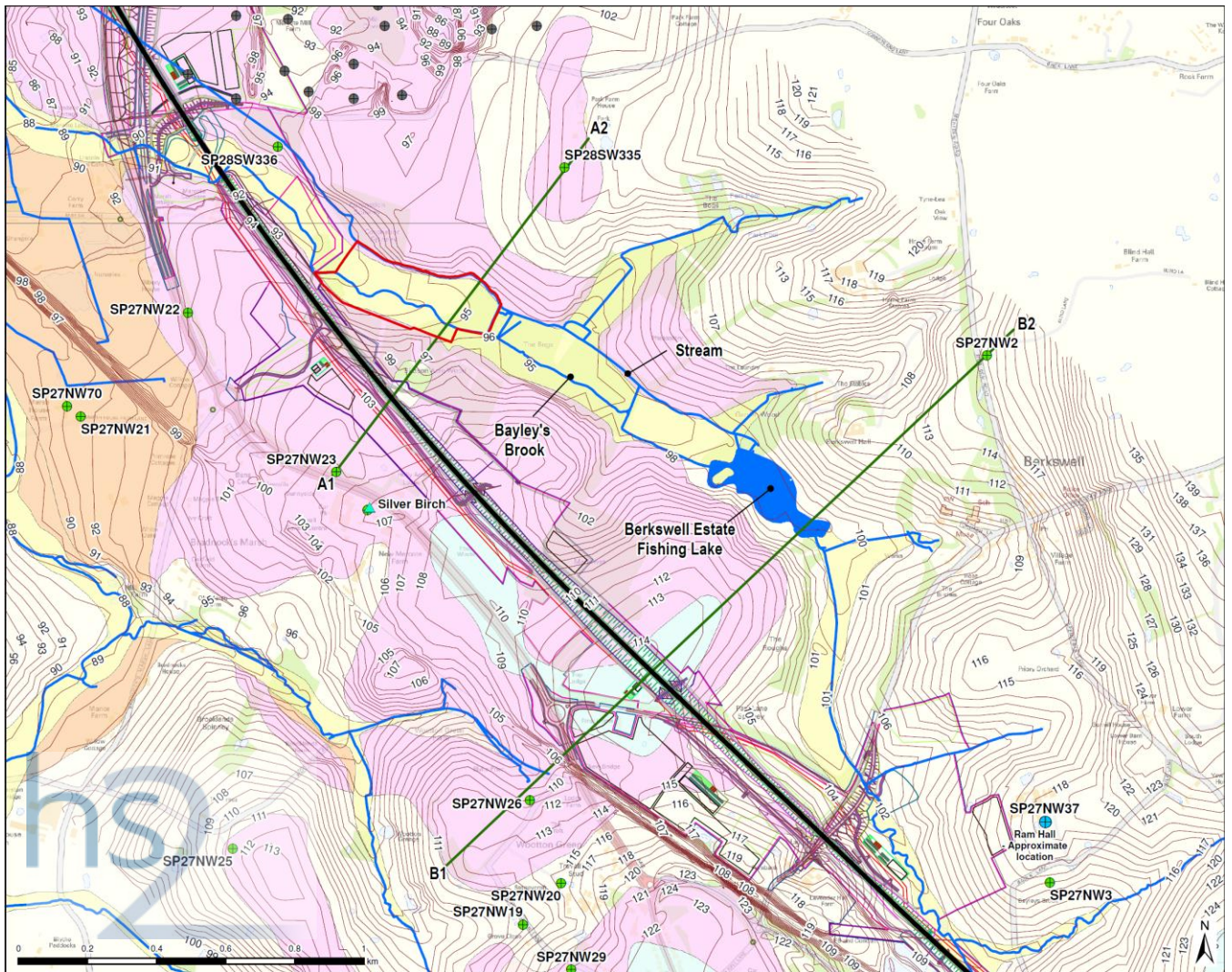


Figure 2: Key of features of Figure 1

LEGEND

- Berkswell Marsh SSSI
- Route
 - Route in tunnel
 - Route on surface
- ▲ Abstraction Licences
- ⊕ EA Boreholes
- ⊕ BGS Boreholes
- ⊕ BGS Confidential Boreholes
- Line of Cross Section
- Elevation (1m Contours)
- Surface Water Body
- Superficial deposits
 - Alluvium
 - River Terrace Deposits
 - Glacial Sand & Gravel
 - Glacial Till

Figure 3: Solid geology

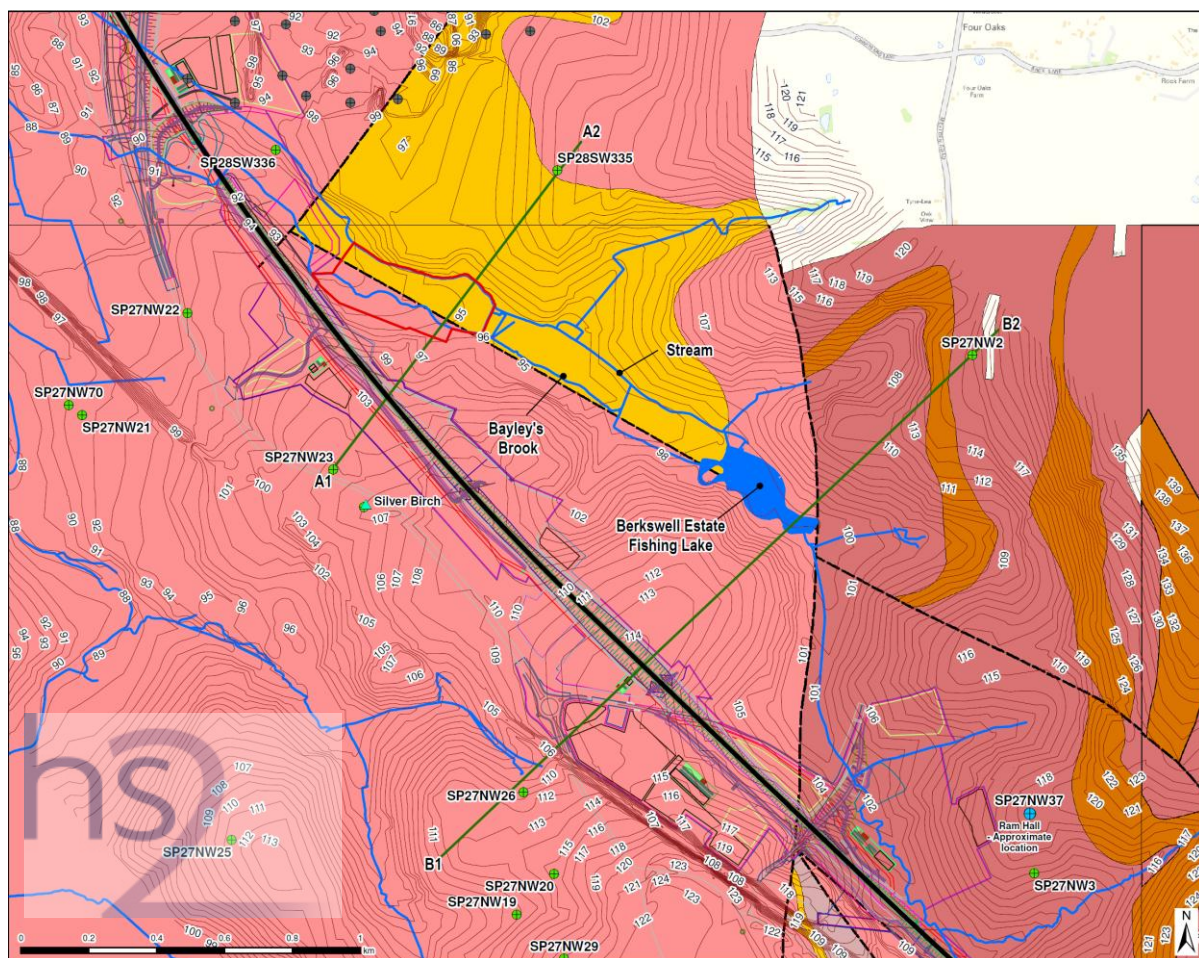


Figure 4: Legend for key of features contained in Figure 3.

LEGEND

- Berkswell Marsh SSSI
- Route
 - Route in tunnel
 - Route on surface
- ▲ Abstraction Licences
- ⊕ EA Boreholes
- ⊕ BGS Boreholes
- ⊕ BGS Confidential Boreholes
- Line of Cross Section
- Elevation (1m Contours)
- Surface Water Body
- Solid Geology
 - Mercia Mudstone Group
 - Bromsgrove Sandstone Formation - Mudstone
 - Bromsgrove Sandstone Formation - Sandstone
 - Tile Hill Mudstone Formation - Mudstone
 - Tile Hill Mudstone Formation - Sandstone
 - Faults

- 4.4.9 Groundwater/ surface water interaction is summarised as follows:
- Bayleys Brook is likely to act as a discharge point for groundwater flow;
 - Bayleys Brook up stream of Berkswell Estate fishing lake is fed by groundwater flow from the Tile Hill Mudstone;
 - Berkswell Estate fishing lake is man-made and is predominantly fed by Bayleys Brook;
 - downstream of Berkswell Estate fishing lake Bayleys Brook is controlled by discharge from Berkswell Estate fishing lake and discharge from Bromsgrove Sandstone;
 - there are also expected to be contributions from the superficial glacial sands and gravel aquifer. There is likely to be a continuous groundwater flow path in the superficial deposits on either side of the valley towards Bayleys Brook; and
 - upstream of Berkswell Marsh SSSI, the superficial deposits are not continuous.
- 4.4.10 The impacts of the proposed Park Lane cutting are summarised as follows:
- there is unlikely to be hydraulic continuity through the superficial deposits between the cutting and Berkswell Estate fishing lake, upstream of Berkswell Marsh SSSI. The cutting largely follows surface water divides, limiting the potential for groundwater flows to be intercepted. Therefore the impact of the cutting on groundwater flow to the fishing lake is assessed as not significant;
 - there is likely to be hydraulic continuity between the superficial deposits and Bayleys Brook along the stretch from Berkswell Marsh SSSI towards the Berkswell Estate fishing lake. The cutting is likely to partially cut-off groundwater flow through the superficial deposits to Bayleys Brook in this location. However, the impact will be limited as the cutting largely follows surface water divides, limiting the potential for groundwater flows to be intercepted. Bayleys Brook and the fishing lake are also expected to receive the majority of their flow contributions from the Tile Hill Mudstone Formations. Therefore any reduction of groundwater flow in the superficial deposit to Bayleys Brook and Berkswell Marsh SSSI is assessed to be low and not significant;
 - the alignment will be out of cutting at the location of Berkswell Marsh SSSI and the direct impact of the cutting on groundwater flow to Berkswell Marsh SSSI is assessed as not significant; and
 - given the paucity of water level and flow data, mitigation measures have been chosen to take into account the uncertainty in the assessment and to allow unimpeded groundwater flow from the cutting to Bayleys Brook and Berkswell Marsh SSSI. This takes a precautionary approach to the assessment and the mitigation of any residual effects.
- 4.4.11 The construction mitigation measures are summarised as follows:
- install temporary cut-off structures around excavations;
 - ensure cut-off structures are driven to sufficient depths to meet an underlying strata or zone of lower permeability; and
 - promote groundwater recharge, such as discharging pumped water to recharge trenches around excavations to maintain baseline groundwater and surface water conditions.
- 4.4.12 The post-construction mitigation measures are summarised as follows:
- incorporate passive bypasses within the design, which could comprise a 'blanket' of permeable material, such as gravel, placed below the cutting, without raising groundwater

levels on the upstream side; and

- implement a regime of pre-construction and post-construction monitoring of flow within Bayleys Brook and groundwater levels within the superficial deposits, including use of appropriate trigger levels and contingency actions and, as agreed with the Environment Agency and Natural England.

5 References

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